IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Before the Board of Patent Appeals and Interferences

Ex Parte:	GAILUS, PAUL
Application Number:	09/933,364
Filing Date:	August 20, 2001
Title:	A Feedback Loop With Adjustable Bandwidth
Group:	2614
Examiner:	LISA HASHEM

BRIEF ON BEHALF OF APPELLANTS UNDER 37 CFR 41.37

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CONTENTS

I. REAL PARTY IN INTEREST

The name of the real party in interest for purposes of this appeal is Motorola, Inc., a Delaware corporation.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to the Applicant, the Applicant's legal representative, or assignee which would directly affect or be directly affected by or having a bearing on the Board's decision in this pending appeal.

III. STATUS OF CLAIMS

Claims 3, 10, 19 and 21 have been cancelled. Claims 1, 2, 4-9, 11-18, 20 and 22 remain in the application. Claim 12 is allowed. Claims 1, 2, 4-9, 11, 13-18, 20 and 22 are being appealed. Claims 1, 2, 4-9, 11, 13-18, 20 and 22 stand or fall together.

In a final Office Action dated January 1, 2008, the Examiner rejected: Claims 1, 2, 4-9, 11, 13-18, 20, and 22 under 35 U.S.C. § 103 (a) as being unpatentable over US 5,722,056 (Horowitz) in view of 'Noise Performance of a Cartesian loop Transmitter' (Kenington); and claims 1, 2, 4-9, 11, 13-18, 20 and 22 under 35 U.S.C. § 102 (e) as being anticipated by US 6,859,097 (Chandler).

IV. STATUS OF AMENDMENTS

No amendments to the claims have been made subsequent to the Final Office Action mailed January 2, 2008.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Although specification citations are inserted below in accordance with 37 C.F.R. § 41.37, these reference numerals and citations are merely examples of where support may be found in the specification for the terms used in this section of the brief. There is no intention to in any way suggest that the terms of the claims are limited to the examples in the specification. Although, as demonstrated by the reference numerals and citations below, the claims are fully supported by the specification as required by law, it is improper under the law to read limitations from the specification into the claims. Pointing out specification support for the claim terminology, as is done here to comply with rule 41.37, does not in any way limit the scope of the claims to those examples from which they find support. Nor does this exercise provide a mechanism for circumventing the law precluding reading limitations into the claims from the specification. In short, the reference numerals and specification citations are not to be construed as claim limitations or in any way used to limit the scope of the claims.

The invention, as defined in Claim 1 and with reference to FIG. 2, is in an electrical device generating a variable output signal, a feedback loop for adjusting the variable output signal, the feedback loop having an input for receiving an input signal, an output for outputting the variable output signal and a loop bandwidth associated with a forward path and a feedback path of the feedback loop, the feedback loop comprising: a power amplifier (231) coupled to the output of the feedback loop in the forward path of the feedback loop; at least one adjustable zero element (212, 213) coupled between the input of the feedback loop and the power amplifier; and at least one adjustable pole element (220, 221) coupled between the input of the feedback loop and the power amplifier, wherein the at least one adjustable zero element and at least one

adjustable pole element are operable to change the loop bandwidth of the feedback loop. (Specification page 6, lines 10-27; and page 10, lines 13-19).

The invention, as defined in Claim 13 and by reference to FIG. 2 and FIG. 7, is in a feedback loop comprising an input for receiving an input signal, an output for outputting a variable output signal, a power amplifier (231) coupled to the output of the feedback loop in a forward path of the feedback loop, at least one adjustable zero element (212, 213) coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop, and at least one adjustable pole element (220, 221) coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop, a method comprising the steps of: generating, in the feedback loop, a loop frequency response having at least one pole and at least one zero, and a closed loop frequency response being characterized by a closed loop bandwidth; and moving (715) a pole in the loop frequency response using the at least one adjustable pole element yielding a change in the closed loop frequency response. (Specification page 6, lines 10-27; page 9, line 29 to page 10, line 8; and page 14, line 21 to page 15, line 4).

The invention, as defined in Claim 20 and by reference to FIG. 2, is a feedback loop having an input for receiving an input signal, an output for outputting a variable output signal and a loop bandwidth associated with a forward path and a feedback path of the feedback loop, the feedback loop comprising: a power amplifier (231) coupled to the output of the feedback loop in the forward path of the feedback loop; at least one adjustable zero element (212, 213) coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop; at least one adjustable pole element (220, 221) coupled between the input of

the feedback loop and the power amplifier in the forward path of the feedback loop; a first mixer (224, 225) in the forward path of the feedback loop coupled between the input of the feedback loop and the power amplifier; and a second mixer (252, 253) in the feedback path of the feedback loop coupled between the output of the feedback loop and the input of the feedback loop, wherein the at least one adjustable zero element and at least one adjustable pole element are operable to change the loop bandwidth of the feedback loop. (Specification page 6, lines 10-27; page 8, lines 19-30; page 9, lines 9-12; and page 10, lines 13-19).

The invention, as defined in Claim 22 and by reference to FIG. 2 and FIG. 7, is in a feedback loop comprising an input for receiving an input signal, an output for outputting a variable output signal, a power amplifier (231) coupled to the output of the feedback loop in a forward path of the feedback loop, at least one adjustable zero element (212, 213) coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop, and at least one adjustable pole element (220, 221) coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop, the feedback loop further having a loop and a closed loop frequency response associated with the forward path and a feedback path of the feedback loop, the loop frequency response having at least one pole and at least one zero and the closed loop frequency response being characterized by a closed loop bandwidth, a method comprising the steps of: moving (715) a pole in the loop frequency response using the at least one adjustable pole element yielding a change in the closed loop frequency response; and moving (725) a zero in the loop frequency response using the at least one adjustable zero element yielding a change in the closed loop frequency response. (Specification page 6, lines 10-27; and page 14, line 21 to page 15, line 13).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Whether Claims 1, 2, 4-9, 11, 13-18, 20, and 22 are patentable under 35 U.S.C. 103(a) over Horwitz (US 5,722,056) in view of Kenington ('Noise Performance of a Cartesian loop Transmitter')?

B. Whether Claims 1, 2, 4-9, 11, 13-18, 20, and 22 are patentable under 35 U.S.C. 102(e) over Chandler (US 6,859,097)?

VII. ARGUMENT

A. Claims 1, 2, 4-9, 11, 13-18, 20, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,722,056 (Horowitz) in view of 'Noise Performance of a Cartesian loop Transmitter' (Kenington).

Applicant respectfully traverses the rejection of claims 1, 2, 4-9, 11, 13-18, 20, and 22. Reconsideration is respectfully requested.

Applicant respectfully submits that the combination of Horowitz and Kenington does not teach or suggest all the claim limitations as set forth in independent claims 1, 13, 20, and 22. Specifically, independent claims 1 and 20 recite "at least one adjustable zero element and at least one adjustable pole element are operable to change the loop bandwidth of the feedback loop", and independent claims 13 and 22 recite "moving a pole in the loop frequency response using the at least one adjustable pole element yielding a change in the closed loop frequency response," which are not taught or suggested in the combination of Horowitz and Kenington.

Horowitz is directed to a linearizer arrangement for compensating for non-linearity in a power amplifier, for example a Cartesian loop with training arrangement, wherein the linearizer arrangement is characterized by an automatic gain control means in the amplifier loop and control means to maintain a constant closed loop gain (see col. 2, lines 41 through 49 and col. 8, lines 3 through 7 of Horowitz). Kenington is directed to a derivation of the noise performance of a Cartesian loop transmitter and highlights the design methods that may also be employed in order to optimize its noise performance (see abstract, Kenington).

In pages 3 and 4, item 5, section titled *" Response to Arguments "*, the Office Action states that Horowitz discloses in training mode, operating conditions such as temperature and frequency are varied (col. 2, lines 11-12). Further, the Office Action states that Horowitz teaches

that the closed loop gain is adjusted or changed or varied during amplitude training according to pre-stored operating condition adjustment factors in a look up table with varying RF frequencies (col. 5, lines 47-52; col. 6, lines 5-56). The Office Action also states that the zeros, poles and gain in the AGC block or circuitry of the radio transmitter depends on the location of Horowitz's attenuators (Fig.2; elements 33 and 34) in the forward path. The Office Actions also states that Horowitz's AGC circuitry which changes the loop bandwidth of the Cartesian feedback loop reads on the Applicant's claimed feature of "at least one adjustable zero element and at least one adjustable pole element are operable to change the bandwidth of the feedback loop" and "moving a pole in the loop frequency response using the at least one adjustable pole element yielding a change in the closed loop frequency response."

Applicant respectfully disagrees with the above statements of the Office Action. Specifically, Applicant disagrees with the Office Action's interpretation of Horowitz's automatic gain control (AGC) circuitry. AGC component (26) as described in Horowitz attempts to maintain constant closed loop gain during the training mode. In order to maintain constant closed loop gain during the training mode, Horowitz's AGC component adjusts the training signal to compensate for loop gain variations due to temperature, frequency etc (col.2, lines 11-12, Horowitz). <u>In other words, Horowitz's system does not change the loop bandwidth, rather it maintains a constant loop gain, which will result in a same loop bandwidth in contrast to Applicant's feedback loop where the loop bandwidth is changed</u>. So, Horowitz's feedback loop cannot provide multiple bandwidths and it cannot allow a different bandwidth input signal to be used, i.e. Horowitz's feedback loop cannot "change the loop bandwidth" or "change the closed loop frequency response" as described in Applicant's claims. For example, in page 10, lines 16-20 of the Applicant's specification as filed, Applicant recites "changing of the pole and zero

locations can be done, for example, to change the closed loop bandwidth to allow a different bandwidth input signal, to adjust the stability properties of the feedback loop by changing the gain margin and/or phase margin, or to change the noise performance of the loop."

Further, Horowitz, in column 2, lines 42-48, discloses “activating the automatic gain control means during at least a portion of the training mode of operation to maintain constant closed loop gain during that portion and to deactivate the automatic gain control means during a transmit mode of operation” which further suggests that Horowitz’s objective is not to change the loop bandwidth, but to maintain the constant loop gain by activating the automatic gain control means only during the training mode of operation.

The Office Action further refers to column 5, lines 47-52 of Horowitz as describing or being analogous to Applicant’s claimed features of “at least one adjustable zero element and at least one adjustable pole element are operable to change the loop bandwidth of the feedback loop”, or “moving a pole in the loop frequency response using the at least one adjustable pole element yielding a change in the closed loop frequency response.” In column 5, lines 47-52, Horowitz recites "adjustment of open loop gain during phase training according to pre-stored operating condition adjustment parameters…adjustment of closed loop gain during amplitude training according to pre-stored operating conditions". In this passage, Horowitz does not teach or suggest changing the loop bandwidth. Rather this passage suggests that in order to maintain constant closed loop gain, the loop variations are compensated using the pre-stored operating conditions, however this compensation for loop variations does not bring a “change [in] the loop bandwidth” or “change in the closed loop frequency response” as described in Applicant’s claims. In column 7, lines 35-38, Horowitz discloses “dynamics inside the AGC block 25 (zeros, poles and gain) are dependent on location of the attenuators 33 and 34 in the forward path”

which actually suggests that the zeros and poles are fixed in Horowitz in contrast to adjustable zero element and adjustable pole element in Applicant's claims.

The Office Action states that page 474, section IV of Kenington provides evidence that including the complex effects of poles and zeros or adjustable poles and zeros in a Cartesian loop transmitter can predict the frequency and magnitude of a peak that is based on a large maximum loop gain. Further, the Office Action refers to Table 1; Fig. 11; page 467-468, section II; page 474, section IV of Kenington and states "Kenington discloses a Cartesian feedback loop (Fig. 1) and further discloses at least one adjustable zero element coupled and at least one adjustable pole element around the feedback loop, wherein the at least one adjustable zero element and at least one adjustable pole element are operable to change the loop bandwidth of the feedback loop." Applicant disagrees. Instead, in table 1; Fig. 11; page 467-468, section II; page 474, section IV, Kenington describes a "typical noise 'frequency response'" or in other words "the frequency characteristics of the noise" (see page 473). More particularly, the cited passage in Kenington describes what is illustrated in figures 11 and 12 of the paper, which is namely that "at high values of loop gain, a peak in the [noise frequency] response exists around 4.5 MHz . . . [which] will manifest itself as peaks in the noise floor". The reference then goes on to point out that this "first-order model used to produce the graph in FIG. 11 is not sufficiently accurate at high frequencies to be able to predict the frequency and magnitude of the peak. . . A more accurate model would need to include the complex effects of the poles and zeros around the loop".

With reference to above citation, Kenington, at best, describes a noise frequency response and mentions that poles and zeros can have complex effects around the loop (although such effects are not shown in the drawings or described in the text). Whereas Applicant's claimed invention is directed to adjustable poles and zeros that operate (when moved) to change the loop

bandwidth of the feedback loop and/or to yield a change in the closed loop frequency response. Further, Kenington's effect of poles and zeros merely suggests effects of a predefined placement of poles and zeros based on the "practical Cartesian loop transmitter [that] was constructed" for purposes of testing the noise models set forth in the paper (see page 470), but does not suggest moving a pole in the loop frequency response using at least one adjustable pole element to yield a change in the closed loop frequency response as set forth in independent claims 13 and 22.

Accordingly, the combination of Horowitz and Kenington do not teach or suggest the claim limitation of "at least one adjustable zero element and at least one adjustable pole element operable to change the loop bandwidth" as recited in independent claims 1 and 20, and the limitation of "moving a pole in the loop frequency response using the at least one adjustable pole element yielding a change in the closed loop frequency response" as recited in independent claims 13 and 22, so the Applicant respectfully requests withdrawal of the rejection of claims 1, 13, 20, and 22 under 35 U.S.C 103.

For the above reasons, Applicant submits that claims 1, 13, 20 and 22 are not obvious in view of the combination of Horowitz and Kenington, and therefore that the rejection of claims 1, 13, 20 and 22 under 35 USC 103 should be withdrawn. Applicant requests that claims 1, 13, 20 and 22 may now be passed to allowance.

Dependent claims 2, 4-9, 11, and 14-18 depend from, and include all the limitations of independent claims 1, 13, 20 and 22. Therefore, Applicant respectfully requests the reconsideration of dependent claims 2, 4-9, 11 and 14-18 and requests withdrawal of the rejection of these claims. Applicant requests that claims 2, 4-9, 11, and 14-18 may now be passed to allowance.

B. Claims 1, 2, 4-9, 11, 13-18, 20 and 22 are rejected under 35 U.S.C. 102 (e) as being anticipated by US 6,859,097 (Chandler).

Applicant respectfully traverses the rejection of claims 1, 2, 4-9, 11, 13-18, 20, and 22. Reconsideration is respectfully requested.

Applicant respectfully submits that Chandler does not anticipate, either expressly or inherently, each and every element as set forth in independent claim 1, 13, 20 and 22. For example, independent claims 1, 13, 20 and 22 recite "at least one adjustable zero element [coupled] between the input of the feedback loop and the power amplifier [in the forward path of the feedback loop]" which is not anticipated either expressly or inherently, in Chandler.

Chandler is directed towards a radio frequency feedback amplifier circuit of high linearity including a forward path having a high gain amplifier and a linear passive feedback circuit, where the high gain amplifier incorporates a bandpass filter in the form of a single resonator which may be tuned so that its resonant frequency is at substantially the signal frequency.

In column 7, lines 48-49, Chandler discloses "[i]t may be desirable to implement a zero in the feedback path to improve dynamic performance and stability" and further in column 10, lines 35-40, Chandler discloses "feedback means in the form of linear passive circuit, wherein means are provided to implement a pole zero pair in a circuit sampling the output of the amplifier means in which the response is achieved by combining signals from points at different phases in the main signal path." These passages suggest that the zero pair is actually used in the feedback path in the Chandler, and further Chandler does not suggest that the zero pair is coupled between the input of the feedback loop and the power amplifier. Therefore, Chandler fails to teach or suggest the limitation of "at least one adjustable zero element [coupled] between the input of the feedback loop and the power amplifier [in the forward path of the feedback

loop]" as described in independent claims 1, 13, 20 and 22. Therefore the rejection of claims 1, 13, 20 and 22 under 35 USC 102(e) should be withdrawn. Applicant requests that claims 1, 13, 20 and 22 may now be passed to allowance.

Further Applicant submits that Chandler fails to teach or suggest "the feedback loop is a Cartesian feedback loop" as recited in claim 6. For example, in page 6 of the Applicant's specification as filed, Applicant discloses "Cartesian feedback loop 200 is referred to as Cartesian because it operates on a complex input signal." In contrast, Chandler's radio frequency feedback amplifier circuit operates entirely at radio frequency, and even figures 1 through 18 fail to depict a loop that operates on a complex input signal. Further, the Office Action states that col. 2, lines 1-12 and FIG. 13 of Chandler disclose that the feedback loop is a Cartesian feedback loop. Applicant disagrees with this interpretation. In col. 2, lines 1-12, Chandler describes that the technique of bandpass feedback is qualitatively different to simple RF feedback and then Chandler goes on to state that the bandpass feedback, like Cartesian feedback, is only concerned with the instantaneous complex envelope of the signal. However, this passage merely compares how the bandpass feedback is qualitatively different from simple RF feedback, but this does not suggest that Chandler's feedback loop is a Cartesian feedback loop and further Chandler has used the term "radio frequency" in conjunction with the feedback amplifier circuit throughout the reference, thereby suggesting that Chandler's feedback loop operates on radio frequency signal, but not on the complex input signal. Even FIG. 13 of Chandler fails to illustrate that the feedback loop operates on the complex input signal or the feedback loop is a Cartesian feedback loop. Therefore, Chandler fails to show or suggest the limitation of "the feedback loop is a Cartesian feedback loop" as recited in claim 6.

Dependent claims 2, 4-9, 11 and 14-18 depend from, and include all the limitations of independent claims 1, 13, 20 and 22. Therefore, Applicant respectfully requests reconsideration of dependent claims 2, 4-9, 11 and 14-18 and requests the withdrawal of the rejection of the rejection of these claims. Applicant requests that claims 2, 4-9, 11, and 14-18 may now be passed to allowance.

Respectfully submitted,

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VIII. CLAIMS APPENDIX

1. (previously presented) In an electrical device generating a variable output signal, a feedback loop for adjusting the variable output signal, the feedback loop having an input for receiving an input signal, an output for outputting the variable output signal and a loop bandwidth associated with a forward path and a feedback path of the feedback loop, the feedback loop comprising:

a power amplifier coupled to the output of the feedback loop in the forward path of the feedback loop;

at least one adjustable zero element coupled between the input of the feedback loop and the power amplifier; and

at least one adjustable pole element coupled between the input of the feedback loop and the power amplifier, wherein the at least one adjustable zero element and at least one adjustable pole element are operable to change the loop bandwidth of the feedback loop.

2. (previously presented) The feedback loop of claim 1 wherein the at least one adjustable zero element is in the forward path of the feedback loop.

3. (cancelled)

4. (previously presented) The feedback loop of claim 1 wherein the at least one adjustable pole element is in the forward path of the feedback loop.

5. (previously presented) The feedback loop of claim 4 wherein the at least one adjustable zero element is in the forward path of the feedback loop, the feedback loop further comprising:

a mixer in the forward path of the feedback loop coupled between the input of the feedback loop and the power amplifier; and

a mixer in the feedback path of the feedback loop coupled between the output of the feedback loop and the input of the feedback loop.

6. (previously presented) The feedback loop of claim 5, wherein:

the feedback loop is used as part of a radio transmitter.

7. (previously presented) The feedback loop of claim 1 wherein the feedback loop is a cartesian feedback loop.

8. (previously presented) The feedback loop of claim 1 wherein the adjustable pole element is a circuit comprising a plurality of elements having impedance that can be selectively coupled to the other elements of the circuit.

9. (previously presented) The feedback loop of claim 1 wherein the at least one adjustable pole element and the at least one adjustable zero element are substantially contained within an integrated circuit.

10. (cancelled)

11. (previously presented) The feedback loop of claim 1 wherein the at least one adjustable pole element comprises two adjustable pole elements.

12 (previously presented) The feedback loop of claim 1 in which the adjustable zero element comprises:

an adjustable first amplifier that amplifies an input signal to the adjustable zero element to create a first amplified signal;

a second amplifier that amplifies the input signal to the adjustable zero element to create a second amplified signal;

a low pass filter that operates on the first amplified signal to create a filtered amplified signal; and

a summer to add the filtered amplified signal and the second amplified signal to create an output signal to the adjustable zero element.

13. (previously presented) In a feedback loop comprising an input for receiving an input signal, an output for outputting a variable output signal, a power amplifier coupled to the output of the feedback loop in a forward path of the feedback loop, at least one adjustable zero element coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop, and at least one adjustable pole element coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop, a method comprising the steps of:

generating, in the feedback loop, a loop frequency response having at least one pole and at least one zero, and a closed loop frequency response being characterized by a closed loop bandwidth; and

moving a pole in the loop frequency response using the at least one adjustable pole element yielding a change in the closed loop frequency response.

14. (original) The method of claim 13 wherein the step of moving a pole is accomplished by switching among a plurality of elements having different impedances.

15. (previously presented) The method of claim 13 further comprising the step of:

moving a zero in the loop frequency response using the at least one adjustable zero element yielding a change in the closed loop frequency response.

16. (original) The method of claim 15 wherein the step of moving a zero is accomplished by adjusting an amplifier with an adjustable gain.

17. (previously presented) The method of claim 13 wherein the power amplifier amplifies the input signal so that it can be transmitted over a radio channel.

18. (previously presented) An integrated circuit comprising the feedback loop of Claim 1.

19. (cancelled)

20. (previously presented) A feedback loop having an input for receiving an input signal, an output for outputting a variable output signal and a loop bandwidth associated with a forward path and a feedback path of the feedback loop, the feedback loop comprising

a power amplifier coupled to the output of the feedback loop in the forward path of the feedback loop;

at least one adjustable zero element coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop;

at least one adjustable pole element coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop;

a first mixer in the forward path of the feedback loop coupled between the input of the feedback loop and the power amplifier; and

a second mixer in the feedback path of the feedback loop coupled between the output of the feedback loop and the input of the feedback loop, wherein the at least one adjustable zero element and at least one adjustable pole element are operable to change the loop bandwidth of the feedback loop.

21. (cancelled)

22. (previously presented) In a feedback loop comprising an input for receiving an input signal, an output for outputting a variable output signal, a power amplifier coupled to the output of the feedback loop in a forward path of the feedback loop, at least one adjustable zero element coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop, and at least one adjustable pole element coupled between the input of the feedback loop and the power amplifier in the forward path of the feedback loop, the feedback loop further having a loop and a closed loop frequency response associated with the forward path and a feedback path of the feedback loop, the loop frequency response having at least one pole and at least one zero and the closed loop frequency response being characterized by a closed loop bandwidth, a method comprising the steps of:

moving a pole in the loop frequency response using the at least one adjustable pole element yielding a change in the closed loop frequency response; and

moving a zero in the loop frequency response using the at least one adjustable zero element yielding a change in the closed loop frequency response.

IX. EVIDENCE APPENDIX

No evidence has been submitted pursuant to 37 C.F.R. §§ 1.130, 1.131, or 1.132, entered by the examiner and relied upon by the appellant in the appeal, or relied upon by the examiner as to grounds of rejection to be reviewed on appeal.

X. RELATED PROCEEDINGS APPENDIX

No decisions have been rendered by a court of the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 C.F.R. § 41.37.